

**CLAIMS:**

1. A medical or dental turbine handpiece including a handle portion for gripping by a user, a drive head connected with the handle portion and forming a turbine housing, a turbine in the turbine housing for rotation about an axis of rotation and having an axial tool bore for receiving a shaft of a rotatable tool insertable into the handpiece, and a pair of axially spaced apart bearings for rotatably supporting the turbine in the turbine housing; characterized in that the handpiece further includes a torque transfer arrangement for transferring torque generated by the turbine to a tool with a shaft portion of non-circular 10 cross-section, the torque transfer arrangement including a locking socket for receiving the shaft portion and having a complementary cross-section for locking the shaft portion against rotation in the socket while permitting axial insertion of the shaft portion into the locking socket, the locking socket being connected to the turbine for rotation therewith.
- 15 2. The handpiece as defined in claim 1, characterized in that the locking socket is integrated into the turbine and is an enlarged portion of the tool bore for receiving a tool with a shaft portion in the form of a radially enlarged locking boss having a diameter larger than a diameter of the shaft of the tool.
- 20 3. The handpiece as defined in claim 1, characterized in that the locking socket is constructed for receiving a shaft portion of triangular cross-section, the locking socket having cross-section complementary to that of the shaft portion.
- 25 4. The handpiece of claim 1, characterized in that the locking socket is a hollow spindle received in the tool bore and fastened therein, the spindle having a cylindrical bore for receiving the shaft portion of the tool and having a protrusion extending radially inwardly into the cylindrical bore for locking the shaft portion in the spindle against rotation, while permitting axial insertion of shaft portion into the locking socket.
- 30 5. The handpiece of claim 4, wherein a surfaces of the protrusion which engages the shaft portion during insertion of the tool into the spindle has a rounded shape for

automatically directing the shaft portion past the protrusion to achieve a self-alignment of the shaft portion in the locking socket during insertion of the tool.

6. The handpiece of claim 4, characterized in that the handpiece further includes a burr retaining arrangement for releasably retaining the tool in the tool bore against axial movement after complete insertion of the tool into the bore the burr retaining arrangement including a pair of complementary, interengaging elements respectively incorporated into the spindle and the tool shaft.
- 10 7. A torque transfer arrangement for a dental handpiece having a turbine for rotatably driving a burr about an axis of rotation, the burr having a burr shaft with a non-circular shaft portion and the turbine having an axial tool bore for receiving the burr shaft, the torque transfer arrangement being characterized in that it includes a locking socket with an axial bore for receiving the shaft portion of the burr shaft, the locking socket being connectable with the turbine for rotation therewith; and a torque transfer member connected with the locking socket for locking the shaft portion against rotation relative to the locking socket.
- 20 8. The torque transfer arrangement of claim 7, characterized in that the locking socket is insertable into the tool bore.
- 25 9. The torque transfer arrangement of claim 7, characterized in that the locking socket is a hollow spindle insertable into the tool bore for connection with the turbine and that the torque transfer member is a wall portion of the spindle extending radially inwardly into the axial bore.
- 30 10. The torque transfer arrangement of claim 7, characterized in that the locking socket is incorporated into the turbine and is an enlarged portion of the tool bore for receiving a shaft portion which is a locking boss on the burr shaft having a diameter larger than the diameter of the burr shaft.

11. The torque transfer arrangement of any one of claims 1 to 10, characterized in that the locking socket has a cross-section complementary to a shaft portion of triangular cross-section.

5       12. The torque transfer arrangement of claim 7, characterized in that the locking portion of the burr shaft is a terminal portion of the burr shaft and the locking socket is a hollow spindle having a cylindrical bore for receiving the burr shaft, the torque transfer member being a protrusion extending radially inwardly into the cylindrical bore for preventing rotation of the locking portion of the burr shaft in relation to the spindle while  
10      permitting axial insertion of the burr shaft into the spindle.

13. The torque transfer arrangement of claim 12, characterized in that end surfaces of the protrusion and the terminal portion which come into mutual contact during insertion of the burr shaft into the spindle have a rounded shape for directing the end surface of the  
15      terminal portion past the protrusion to achieve a self-alignment of the terminal portion relative to the protrusion during insertion of the burr.

14. The torque transfer arrangement of claim 12, characterized in that the spindle further includes a burr retaining element extending into the cylindrical bore for releasably  
20      engaging a complementary retaining element on the burr shaft to releasably lock the burr shaft in the cylindrical bore against axial movement.

15. A medical or dental turbine handpiece for a rotatable tool, having a handle portion for gripping by a user, a drive head connected with the handle portion and forming a  
25      turbine housing, a turbine in the turbine housing for rotatably driving the tool about an axis of rotation and having an axial tool bore for receiving the shaft of the tool, a pair of axially spaced apart bearings for rotatably supporting the turbine in the turbine housing, and a pressurized drive air conduit for supplying pressurized turbine drive air to the turbine, characterized in that the bearings are air bearings, and that the handpiece includes  
30      a bearing air conduit for supplying pressurized bearing air to the air bearings independent of the turbine drive air.

16. The handpiece of claim 15, characterized in that it further includes a controller for controlling a flow of the pressurized drive air through the drive air conduit separate and independent from a flow of the bearing air through the bearing air conduit.

5 17. A method of operating a dental handpiece including an air turbine driven by pressurized drive air and a pair of air bearings for supporting the air turbine in the handpiece and operated by pressurized bearing air, characterized by the steps of supplying pressurized bearing air to the air bearings, and supplying pressurized drive air to the turbine independent of the bearing air, the step of supplying bearing air being commenced  
10 prior to supplying drive air and continued at least as long as the step of supplying drive air.

18. A medical or dental turbine handpiece for a rotatable tool, having a handle portion for gripping by a user, a drive head connected with the handle portion and forming a turbine housing, a turbine in the turbine housing for rotatably driving the tool about an axis of rotation and having an axial tool bore for receiving the tool, and a pressurized turbine drive air supply conduit, characterized in that the drive head includes a turbine drive air supply chamber connected to the drive air supply conduit for receiving drive air, and that the supply chamber extends about the turbine chamber for supplying turbine drive air to the turbine at least at two spaced apart locations distributed about the axis of  
15 rotation.  
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19. The handpiece of claim 18, characterized in that the turbine drive air supply chamber is an annular chamber extending concentrically about the axis of rotation.

25 20. The handpiece of claim 19, characterized in that the supply chamber supplies drive air to the turbine at a multitude of locations evenly distributed about the axis of rotation.

21. The handpiece of claim 18, characterized in that the drive head further includes a Venturi passage connecting the drive air supply chamber to the turbine chamber for  
30 accelerating the drive air prior to impinging on the turbine.

22. The handpiece of claim 21, wherein the Venturi passage includes multiple air guide vanes for directing the turbine drive air onto the turbine in a direction generally radially inwardly towards the axis of rotation.

5    23. A medical or dental turbine handpiece for a rotatable tool having a handle portion for gripping by a user, a drive head connected with the handle portion and forming a turbine housing, a turbine in the turbine housing for rotatably driving the tool about an axis of rotation and having an axial tool bore for receiving a shaft of the tool; and a pair of axially spaced apart bearings for rotatably supporting the turbine in the turbine chamber  
10    for rotation about the axis of rotation, characterized in that the bearings are air bearings.

15    24. The handpiece of claim 23, characterized in that each air bearing includes a bearing stator having the shape of a spherical section and a bearing rotor of complementary shape, and that the bearing rotor and stator are shaped to define an intermediate bearing gap of even width throughout.

20    25. A medical or dental turbine handpiece having a handle for gripping by a user, a drive head attached to the handle and forming a turbine chamber, an air driven turbine in the turbine chamber for rotatably driving a tool, the turbine being operated by turbine drive air, and a swivel connector for rotatably connecting the handle to an umbilical cord including at least a supply conduit for the turbine drive air, characterized in that the swivel connector has an angled connector body for connecting the handle and the umbilical cord at an angle of less than 180 degrees to reduce user wrist strain.

25    26. The handpiece of claim 25, characterized in that the handle and the umbilical cord are connected at an angle between 90 and 180 degrees.

30    27. A medical or dental turbine handpiece for a rotatable tool having a shaft including a drive head for rotatably supporting the tool and forming a turbine housing, a turbine in the turbine housing for rotatably driving the tool about an axis of rotation, a pair of axially spaced apart bearings for rotatably supporting the turbine in the turbine housing, a pressurized drive air conduit connected to the turbine housing for supplying pressurized

turbine drive air to the turbine, and an exhaust conduit connected to the turbine housing for removing spent turbine drive air from the turbine housing, characterized in that the handpiece further includes a shut-off valve for reducing turbine run down time when the supply of turbine drive air is stopped, that the shut-off valve is connected to the drive air conduit and the exhaust air conduit and that the shut-off valve includes a closure member normally biased into a closed position wherein the closure member closes both the drive air and exhaust conduits and movable by drive air pressure to an open position wherein the closure member permits passage of drive air and exhaust air through the drive air and exhaust conduits respectively.

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28. The handpiece of claim 27, characterized in that the bearings are air bearings, that the handpiece further includes a bearing air supply conduit connected to the drive head for supplying pressurized bearing air to the air bearings, and that the supply conduit supplies the bearing air independent of the position of the closure member of the shut-off valve.

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29. The handpiece of claim 28, characterized in that the shut-off valve is incorporated into the handle portion and that the closure member is a sleeve axially movable in the handle portion between the open and closed positions.

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30. A medical or dental turbine handpiece for a rotatable tool having a working tip, the handpiece including a handle portion for gripping by a user, a drive head connected with the handle portion by an intermediate neck portion, the drive head forming a turbine housing, a turbine in the turbine housing for rotatably driving the tool about an axis of rotation and having an axial tool bore for receiving the shaft of the tool, and a pair of axially spaced apart bearings for rotatably supporting the turbine in the turbine housing, characterized in that the handle portion has a longitudinal central first axis and the neck portion has a longitudinal central second axis, that the drive head, neck portion and handle portion being interconnected in such a way that an angle enclosed by the axis of rotation of the tool with the first axis is larger than 90 degrees and with the second axis is less than 90 degrees, and that the second axis is oriented at an angle to the first axis such that the tool tip coincides with the first axis.

31. A medical or dental turbine handpiece for a rotatable tool, including a handle portion for gripping by a user, a drive head forming a turbine housing, an intermediate neck portion connecting the drive head with the handle portion, a turbine in the turbine housing for rotatably driving the tool about an axis of rotation and having an axial tool bore for receiving the shaft of the tool, and a pair of axially spaced apart bearings for rotatably supporting the turbine in the turbine housing, characterized in that the handpiece further includes a neck connecting arrangement for releasably connecting the neck portion to the handle portion, that the neck connecting arrangement includes a socket portion on one of the neck portion and the handle portion and a plug portion on the other of the neck portion and handle portion, and that the plug and socket portions are of complementary shape for non-rotatably connecting the neck and handle portions.
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32. The handpiece of claim 31, characterized in that the neck connecting arrangement further includes a snap lock for releasably locking the plug portion in the socket portion.
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33. A dental burr for a dental turbine hand piece, the burr having a working tip and a shaft for insertion into the hand piece, characterized in that the shaft includes a shaft portion of non-circular cross-section for torque transferring engagement with a burr receiving locking socket in the hand piece.
34. The burr of claim 33, characterized in that the shaft portion has a triangular cross-section.